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A RETROSPECTIVE STUDY OF A 1992 SUBCOHORT OF AIR FORCE PERSONNEL EXPOSED TO HAZARDOUS NOISE BY AIR FORCE SKILL CODE

By

JIM ALAN DAVIS, B.S., D.V.M.

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DEDICATION

To my wife, Brenda, who has been my dearest and best friend for many years.

"A wife of noble character who can find? She is worth far more than rubies." Proverbs 31:10

"Many women do noble things, but you surpass them all." Proverbs 31: 29

A RETROSPECTIVE STUDY OF A 1992 SUBCOHORT OF AIR FORCE PERSONNEL EXPOSED TO HAZARDOUS NOISE BY AIR FORCE SKILL CODE

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JIM ALAN DAVIS, B.S., D.V.M.

THESIS

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To Ms. Julie Shadoan of Fort Detrick, MD for her many hours of work, I express a special thanks. For her tireless efforts to overcome program errors we seemed to encounter at every turn, I am extremely grateful. This project could not have been completed without her insight, skills, persistence, optimism.

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A RETROSPECTIVE STUDY OF A 1992 SUBCOHORT OF AIR FORCE PERSONNEL EXPOSED TO HAZARDOUS NOISE BY AIR FORCE SKILL CODE

Jim Alan Davis, D.V.M.
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School of Public Health, 1994

Supervising Professor: Sharon Cooper, Ph.D.

This study measured the magnitude of risk of the 1992 cohort of employees (enlisted, officer, and civilian) on the United States Air Force Hearing Conservation Program by occupational codes (Air Force Skill Codes, AFSC). Some 160,062 individuals that received annual audiograms during this period were eligible for analysis. To enhance precision, females were excluded from the study since they were less than 6% of the subcohort resulting in 151,512 potential male employees to analyze. The study further restricted this group to view only the most recent audiogram for each individual that had a valid service and rank code. The final number of this subcohort was 107,421. Only AFSCs with 100 or more employees were analyzed. This represented 117 AFSCs with 93,854 audiograms (87.4% of 107,421). The age and race distribution of the 107,421 audiograms were used as the standard for direct adjustment of each AFSC. Risk of Permanent Threshold Shift (PTS) ranged from several AFSCs with 0% to civilian aircraft mechanics with 11.4%. The overall crude risk for the standard was 2.3%. Six of the top ten risk categories were civilian even though only 28% of the AFSCs analyzed were civilian. Due to wide confidence intervals, the Air Force should use caution in implementing new procedures from these findings until they are replicated in a subsequent year group.

TABLE OF CONTENTS

TABLE OF CONTENTS

Page

LIST OF TABLES

LIST OF FIGURES

Page

SECTION I
INTRODUCTION

A RETROSPECTIVE STUDY OF A 1992 SUBCOHORT OF AIR FORCE PERSONNEL EXPOSED TO HAZARDOUS NOISE BY AIR FORCE SKILL CODE

A. SPECIFIC AIMS

This research is designed to provide information on the risk of developing permanent hearing loss across occupations in the United States Air Force. All Air Force individuals exposed to hazardous noise (over 85 dB-8 hour weighted, over 115 dB intermittent noise, or over 140 dB impact or impulse noise) and free of significant hearing loss are entered into the Air Force Hearing Conservation Program (AFHCP).[1]

The AFHCP has been conducted by hundreds of highly trained technicians, physicians, and allied support personnel for many years. These efforts have resulted in a database (Air Force Hearing Conservation Data Registry - HCDR) with over three million audiometric records.[2] Each year the Air Force Annual Hearing Conservation Report is compiled to summarize data for the previous year.[3] The report contains a myriad of useful analytical and epidemiologic information. Incidence of Permanent Threshold Shifts (PTS) is reported annually in this report as required by Air Force regulations.[4] It also contains a frequency analysis of PTS for various career fields for officers, enlisted, and civilian employees, but the career fields cover broad areas. The career fields are not specific for occupations identified by Air Force Skill Codes (AFSC).

With scores of different Air Force Skill Codes on the AFHCP, it is extremely

beneficial, in terms of targeting appropriate interventions, to identify those AFSCs showing the highest risk of hearing loss compared to other AFSCs.

Therefore, the specific aims of this study are :

(1) to identify the ten AFSCs showing the highest risk for hearing loss, and

(2) to identify the ten AFSCs on the AFHCP that have the lowest risk of developing permanent hearing loss.

B. SIGNIFICANCE

The Department of Labor (DOL) and Veterans Administration (VA) pay millions of dollars annually as a result of claims of hearing loss by Department of Defense (DOD) civilian employees and former military personnel. The DOL reported the average cost in civilian Air Force employee claims was $4,969,417 annually from 1989 to 1992. [4] On average, 993 civilian employees made claims annually to the DOL during this period. The VA only pays claims to prior military personnel with service connected hearing loss. In 1992 the VA had 7,531 Air Force cases on the active roll where hearing loss was considered the primary disability. There were 47,699 Air Force cases on the active roll during the same period where hearing loss was considered a secondary disability. Primary disability recipients received a total of $25,431,576 in 1992 alone. Financial payments received by individuals in the secondary disability category are not kept by the VA. [5] When Air Force costs are combined with other DOD agencies, hearing loss claims paid by the United States government are substantial.

Any effort to reduce hearing loss will ultimately have an impact by reducing claims paid and alleviating the long term physical disabilities so many service connected personnel experience. By identifying the ten AFSCs with the greatest risk for hearing loss,

Air Force management and Military Public Health officers can search for factors that may put these individuals at increased risk and focus preventive medicine efforts on these high risk occupations. Remediation measures can then be designed to circumvent further preventable hearing losses. Amelioration measures may appear to be beneficial enough that they may be instituted Air Force wide.

By identifying the ten AFSCs on the AFHCP with the lowest risk of hearing loss, AF management will be able to further analyze the AFHCP. Factors such as lower levels of noise exposure, better education programs and different types of hearing protection could be identified as protective for these occupations. The discovery of these protective factors could of value to the Air Force and other DOD agencies in further curtailing occupational hearing loss.

C. HEARING LOSS HISTORY and SUSCEPTIBILITY

Loss of hearing from occupational noise has been known for over 300 years. [6] Development of technology during this century has brought louder and louder machines and industrial processes into the workplace. [7,8] In 1830 "osbroke [9] spoke of certain occupations predisposed to hearing loss.

> The blacksmiths' deafness is a consequence of their employment; it creeps on them gradually, in general at about forty or fifty years of age. At first the patient is insensible of weak impressions of sound; the deafness increases with a ringing and noise in the ears, slight vertigo, and pain in the cranial bones, periodical or otherwise, and often violent.

As the Industrial Revolution advanced, it also brought hearing loss to millions of

Americans in industry [7]. Noise is now the most common hazard in the workplace. [10] Over 40 million Americans suffer hearing loss from various sources. [7] Over 7,900,000 U.S. workers are exposed to noise levels at or above 80 dB. [10] It is estimated that more than 20 billion dollars have been paid out in compensation for hearing loss to workers. Noise-induced hearing loss is listed by the Center for Disease Control as one of the ten leading occupational diseases in the U.S. [11]

It has long been recognized that some individuals are more susceptible to hearing loss than others. [2,12-14] There has been much speculation about potential factors causing this inter-individual variation including: heredity, diet, blood and nutrition supply, stress, drugs, metabolism, race, age, sex, eye color, non-occupational exposure to noise, smoking, previous hearing loss, systemic diseases (cardiovascular, hypothyroidism, diabetes, hyperlipoproteinemia), use of hearing protection, consumption of salicylates, plasma LDL-cholesterol concentration, gunfire, and tinnitus. [2,7,12,13,15-18] If we can learn more about factors that predispose people to hearing loss, we may be able to reduce hearing loss.

D. RISK FACTORS as CONFOUNDERS

Of all the potential confounders listed above as potentially affecting susceptibility to hearing loss, one is likely to affect the study. Presbycusis, a slow progressive deterioration of hearing not attributable to any cause except aging, has been found in many occupational hearing loss studies as a major factor in hearing loss. [15,19] Lutman and Spencer[20] studied 2,162 subjects free of material conductive impairment. Study participants ranged from 17 to 80 years. Their findings showed increased hearing threshold levels with age. Bauer *et al.* [18] studied 47,388 noise exposed workers in Austria and found that age was a dominating factor in determining hearing threshold loss. Ribak *et al.* [21] studied 777

aircrew members of the Israeli Air Force for permanent hearing threshold shifts. It was discovered that age was highly correlated with hearing loss ($p<0.001$) while aircraft type and accumulated flying time played a minor role. Fitzpatrick, in a subsequent study of 211 U.S. Army aviators, found noise exposure as measured by total flight hours (1,000 to 4,000 hours) increased threshold shifts four-fold ($p<0.001$), but he also found hearing loss with clear progression in each age group ($p<0.001$). [22]

Gender also seems to play an important role in susceptibility to hearing loss. One auditory brainstem response study has shown women have different lengths of time for brainstem response than men. Explanation for this was hypothesized: lighter ossicles in women, shorter cochleas, and variations in the skull (men have thicker skull bones than women and different shapes of the skull bones). [17] Royster *et al.* [23] studied audiometric test data on 14,000 industrial employees from several different types of industries in North Carolina. The study found that black females exhibited the lowest hearing threshold levels. White males had the highest hearing threshold levels. Black males and white females had similar hearing threshold levels. Royster *et al.* [23] stated "that meaningful evaluations of industrial audiometric data bases are not possible unless race and sex compositions of the population are considered." Johnson's [24] review of field studies on industrial exposure also showed an increase in noise induced permanent threshold shift (NIPTS) in men compared with women. Johnson postulates that teenage boys are involved in far more noise activities than teenage girls. He states this trend is expected to continue through adulthood. Male non-occupational exposures (chain saws, guns, etc.) predispose them to NIPTS. In the study by Bauer [18] previously mentioned, of the 47,388 noise exposed workers, sex and age were found to be the dominating factors in determining hearing threshold.

The effect of race on hearing sensitivity has been studied and may affect data interpretation. As mentioned earlier, Royster *et al.* [23] noted a difference in hearing threshold

level, by race. This study was performed in 1979. An earlier study of patients at Johns Hopkins Hospital in 1930 by Bunch and Raiford [25] indicated better hearing in blacks than whites. Karsai *et al.* [26] studied a population of 836 longshoreman to analyze hearing differences in men from several different subcultures. Black Americans had superior hearing compared to four other groups, all of which were white. The four other groups (Italian, Irish, Yugoslav, and White American) were not significantly different.

The amount of melanin in the skin and eye appear to be correlated with susceptibility to hearing loss. This hypothesis is supported by studies like those in the previous paragraph discussing differences in darker and lighter races. LaFerriere *et al.* [27] discovered the density of melanocytes throughout the labyrinth varies according to skin pigmentation. The pale person will have hardly any melanin in the stria vascularis. Barrenas and Lindgren [12] cited the important discovery of the correlation of eye color and inner ear melanin by Bonaccorsi in 1965. The results of studies correlating eye color with hearing loss are mixed. Hood *et al.* [28] tested 38 subjects for temporary threshold shifts (TTS). They were divided into four groups by eye-color: dark brown, light brown, green-grey, and blue. The results confirmed earlier studies that TTS is related to melanin content of the iris. Carter *et al.* [29] studied 118 otologically normal Australian soldiers. In this study left ears from soldiers with eye color indicating no melanin pigmentation of the iris had poorer hearing at 3 kHz ($p<0.05$) than soldiers with melanin pigment. Although the majority of studies do indicate eye color is correlated to hearing loss, a few do not. For instance, Karlovich (1975) tested 45 young adults for auditory fatigue and found no significant differences in brown, green-gray, and blue iris categories. [30] Hood *et al.* [28] attempted to explain why Karlovich produced results different from others. He stated the methodology Karlovich used of pulsed tones rather than continuous tones may have produced these misleading results. The protective effects of melanin in the inner ear may be

due to binding of noise induced free radicals. This may protect the hair cells against a hazardous overload produced by excessive noise. [12,31] Carlin and McCroskey [32] (1980) studied 100 industrial employees and concluded that eye color may be related to the effects of noise on hearing. They suggested any future study of PTS or TTS should consider eye color.

Nonoccupational noise may be a confounder. Occasional exposure to loud rock-and-roll and music will not produce significant hearing damage. Habitual exposure though may cause damage between 2,000 and 8,000 kHz. [7] Also gunfire can show a detectable effect on hearing threshold, in particular on the left ear. [7,33] Very little can be done to control for this variable since its impact cannot be clearly defined.

Smoking has also been implicated as affecting hearing susceptibility. The results of studies have varied. Barone *et al.* [16] studied 2,348 noise-exposed white males and found smokers had a statistically significant increased risk of noise-induced hearing loss. Pyykko *et al.* [15] carried out a detailed analysis of risk factors for hearing loss on 199 Finnish forestry workers. They concluded the effect smoking has on hearing loss is still uncertain. Their results showed no significant difference in smokers versus nonsmokers.

SECTION II
METHODS AND PROCEDURES

A. SELECTION and RECRUITMENT of STUDY POPULATION

Since all individuals in the HCDR are exposed to hazardous noise (as defined by the Air Force) and are otologically normal, all individuals in the registry could be potential candidates for this study. The study population was selected from the HCDR with three primary criteria in mind.

Accuracy of data is of paramount importance so the results would be valid and information bias would be minimized. Though the HCDR has been active for several years, confidence in the quality of data has improved significantly in recent years. During the last few years a thorough quality control has been implemented to insure data collected at base level is entered properly and completely into the HCDR. For this reason, selection of a more recent subcohort would provide the highest quality data.

A large enough sample size is also important so that adjusted risks would be reliable. As with any study, sample size may mean the difference between statistically significant results and just interesting information. The larger the sample size the better, but it still must be kept small enough to be manageable for analysis. In 1991 alone the HCDR had 198,890 DD Forms 2216 entered into the database. The DD Form 2216 (Hearing Conservation Data form) is a multipurpose form used by the Air Force to record audiograms for several different purposes such as 90-day follow-ups, termination, annual, etc. After identifying those audiograms marked with the code for annual audiograms, 167,144 were analyzed for hearing loss.[3] The 1992 number of DD Forms 2216 entered into the HCDR was 198,484. Once again when only those coded for annual audiograms were

isolated 160,062 were analyzed for hearing loss (Figure 1). [34]

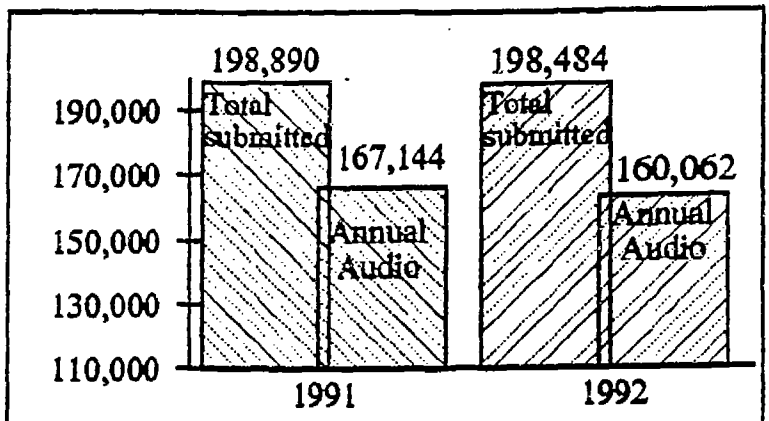


Figure 1. DD Forms 2216(Hearing Conservation Data form) for 1991 and 1992 in the HCDR by total submitted for data entry and by number of those being annual audiograms.

One last concern is that the data being analyzed should be current enough to reflect current working conditions in the United States Air Force. Currency of data will help Air Force management use the results of this study immediately. The more current the data, the more confidence can be placed that inferences from the results in the study are applicable to the present work force.

To support the three objectives stated above, part of the cohort of 1992 individuals entered on the HCDR was selected for the study population. New accessions are not allowed to start working in an AFSC unless they are cleared for medically normal hearing. New accessions into the military workforce for 1992 were not included since it could not be documented they were disease free the 12 months prior to their audiogram. The 1992 cohort that were on the AFHCP in 1991 received their annual audiogram sometime in 1992. This group should adequately meet all three requirements making the study data accurate, reliable, and immediately usable by the Air Force.

Since sex was implicated in previous literature as being a possible risk factor for disease, it was considered in this study. Incorporation of sex (a dichotomous variable) would double the number of strata in the final analysis. This effect of doubling cells to be analyzed could cause many unstable cells (cells < 5) if not enough women were in this subcohort. Of the 160,062 only 8,550 were female (Table 1). Since this group was less than 6% of the subcohort and would probably decrease the precision of the study, it was decided to further restrict the study to just males. Since the goal of the study is to identify high risk AFSCs, removing sex as a confounding variable in the design phase was parsimonious.

Table 1. Distribution of initial 1992 cohort for all races and AFSCs * by sex and military status.

	Military		Civilian		All	
SEX	N	%	N	%	N	%
FEMALE	6,873	5.18	1,677	6.13	8,550	5.34
MALE	125,822	94.82	25,690	93.87	151,512	94.66
ALL	132,695	100.00	27,367	100.00	160,062	100.00

* AFSC - Air Force Skill Code

This study further restricted the 151,512 annual audiograms from males to view only the most recent audiogram for each individual that had a valid service (Regular Air Force, Reserve, National Guard, or other) and rank (officer, enlisted, civilian grade) code. The final number of individuals/audiograms in this subcohort was 107,421. The decrease in the 1992 male subcohort from 151,512 to 107,421 was probably related to the individual

receiving more than one annual audiogram, double testing (i.e. Jan 92 then again Dec 92) where windows of annual audiogram might overlap, improper coding on the form , or improper data entry.

Further restrictions were necessary. The individual unit of analysis in this study is the AFSC. If an AFSC had too few individuals in it, its adjusted risk would have such wide confidence intervals the point estimate would lose meaningful precision. Also the study is geared to have Air Force-wide application, therefore it was also important to select AFSCs with large enough numbers of individuals to significantly impact the Air Force. Therefore, some cut-off point would need to be determined for the number of employees per AFSC to be analyzed.

The subcohort of 107,421 was analyzed to see how many AFSCs it represented and the number of employees in each. When AFSCs where broken out initially it resulted in 4,648 different codes (Appendix A). There were several possible reasons for such a large number. The main reason is many AFSCs have suffix identifiers that the database treats separate AFSCs. For instance, a 908XX, 90830, 90850, and 90870 all represent the 908 series for an enlisted public health technician. Military Personal Center and the Civilian Personnel Center at Randolph AFB were consulted on all the different coding variations of AFSCs for civilian, officer, and enlisted. To combine individual codes to make meaningful groupings, a strategy was developed. Any AFSC code with over seven employees was combined with its parent code. The number seven was chosen because even if three codes with seven each where combined, the parent code would still only be 21; a number too small to analyze. Rarely did any AFSC code with seven individuals have another code with more than two individuals that would have contributed to their parent code therefore the rationale for the method seemed reasonable, although arbitrary. AFSCs were combined in the manner described above resulting in 2,718 total AFSC codes still

listed.

The distribution of AFSCs after this combining made the decision for cutoffs simpler (Figure 2). The preponderance of employees were in AFSCs with more than 100 persons. One hundred seventeen AFSCs represented 93,854 individuals with a cut-off of 100 persons per AFSC (Appendix B). Thus 87. 4% of the subcohort of 107,421 could now be analyzed with a manageable number of AFSCs.

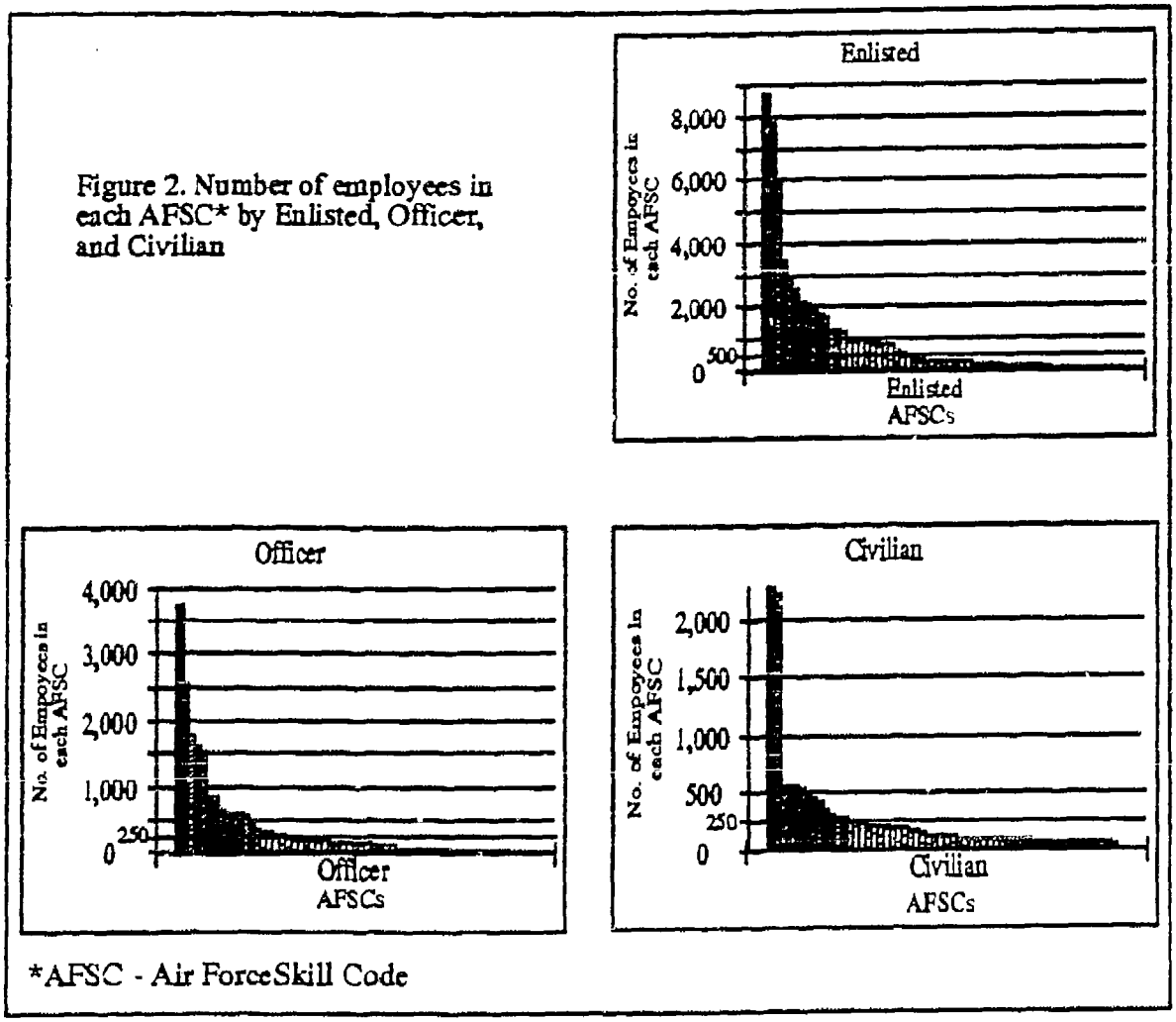


Figure 2. Number of employees in each AFSC* by Enlisted, Officer, and Civilian

*AFSC - Air ForceSkill Code

B. SELECTION of COMPARISON or STANDARD GROUP

One of the formidable hurdles of any retrospective cohort study is to identify an adequate comparison group. The comparison group in a cohort study is utilized to compare the disease experience in an unexposed group to that of the exposed study group. Usually a comparison is chosen in one of these a[illegible]: internal comparison group, external comparison group, or comparisons with the general population. [35] Since the goal of this study is to rank the magnitude of effect in each AFSC, a comparison group was not necessary.

A standard group though was needed for adjustment in the analysis. Since different AFSCs would have different proportions of race and age groups, adjustment using a standard distribution of these potential confounders would remove any bias they might produce in the crude point estimate for that AFSC. For direct standardization the standard group can be one of the groups under study, a combination of groups under study, or some external group. The actual values of the adjusted rates would depend on which standard is chosen. Therefore the choice of the standard would alter the magnitude of effect in the adjusted rate, however, the magnitude in differences of adjusted rates would not vary. [34,37] This means the irregardless of the standard chosen the ranking of rates would not be altered. For convenience the subcohort of 107,421 males were selected to be the standard.

C. DATA COLLECTION and DATA MANAGEMENT STRATEGIES

Data and preliminary analysis were obtained from the HCDR at Ft. Detrick, MD. The researcher had extensive communications with Armstrong Lab (Brooks AFB, Texas) Air Force Military Personnel Center (Randolph AFB, Texas) and Civilian Personnel Center (Randolph AFB, Texas) to resolve apparent inconsistencies in occupational coding.

Collaboration between the researcher and HCDR was necessary to adjust occupational codes and perform the raw data analysis. Further analysis were accomplished by the researcher on a 386-IBM compatible personal computer using a software spreadsheet.

D. PROTOCOLS or INSTRUMENTS USED

All data was furnished courtesy of the U.S. Air Force. No data contained any personal information such as social security numbers.

No instruments were used in this study.

E. INDEPENDENT, DEPENDENT & CONFOUNDING VARIABLES

INDEPENDENT VARIABLE:

The independent variable for this study was each AFSC under study.

DEPENDENT VARIABLE:

The dependent variable for this study was the presence or absence of permanent hearing threshold shift (PTS). PTS was defined as an increase (an average of 10 dB at 2,000, 3,000, and 4,000 Hz, either ear) in the hearing threshold relative to the baseline audiogram after a 40 hour noise free period. [1]

CONFOUNDING VARIABLES:

Sex is regarded in the literature as a possible confounding variable. By restriction it was removed from the study during the design phase.

Adjustment was made for age and race during the analysis of this study. Age was readily available on the current HCDR. Race was used as a surrogate for melanin in the inner ear. The data on race was obtained from another DOD database and was merged with the HCDR database.

F. METHOD of DATA ANALYSIS

As with any retrospective cohort study, all participants should be disease free at the beginning of the review period. At the beginning of 1992 all individuals that had been on the AFHCP in 1991 should have had normal hearing. If one of these individuals had a PTS in 1991 they would normally be removed from a hazardous noise area thereby removing them from hazardous noise. Occasionally, by direction of a physician or audiologist , an individual with a PTS in 1991 may have been reassigned a new baseline for his hearing level and considered to have normal hearing. These individuals would stay on the AFHCP and continue in their work centers. Each one of the individuals on the AFHCP in 1991 should have received their annual audiogram sometime during 1992 unless they changed jobs, left the military, or were removed from a hazardous noise area for medical reasons. During the twelve month period of 1992, annual audiograms entered into the HCDR were categorized as either normal or a permanent threshold shift (PTS).

To develop the standard, the subcohort of 107,421 was stratified by age and race. The percentages generated in this analysis would be used later as the multiplicand with the stratum rates of each AFSC (Table 2).

Table 2. Frequency distribution of male subcohort (n = 107,421) by age and race. (Derivation of the standard weight)

AGE	White		Black		Other	
	N	%	N	%	N	%
18-27	20,865	19.42	2,225	2.07	6,402	5.96
28-37	32,159	29.94	3,707	3.45	11,378	10.59
38-47	13,464	12.53	1,536	1.43	7,425	6.91
> 47	4,563	4.25	539	0.50	3,158	2.94

The measure of disease frequency studied was cumulative incidence (CI). This measure is also often referred to simply as risk. Since CI is the proportion of people that have become diseased in a given period, it fits this study well. [4]

$$CI = \frac{\text{number of new cases of a disease (PTS) during a given period of time}}{\text{total population at risk (all AFSCs)}}$$

The crude cumulative incidence for each AFSC was adjusted for age and race by direct adjustment using 12 age/race strata. The adjusted cumulative incidence yielded a more accurate point estimate. A 95% confidence interval around the adjusted point estimate was also calculated (Appendix C & D).

SECTION III
RESULTS

The overall crude rate of PTS for the study group of 107,421 was 2.52%. This figure matches the results of the 1992 Air Force Annual Hearing Conservation Report which calculated 2.5% for a crude rate. [34]

Analyzing the group of 117 AFSCs under study and comparing them to the 1992 Air Force Annual Hearing Conservation Report revealed similar crude rates in officers, enlisted, and civilians (Table 3). Most notable in the adjusted rates in these categories is the increase in the enlisted rates and the decrease in the civilians. By removing the effect of age and race the enlisted and civilian overall adjusted rates are almost identical yet both are distinctly higher than the officer category.

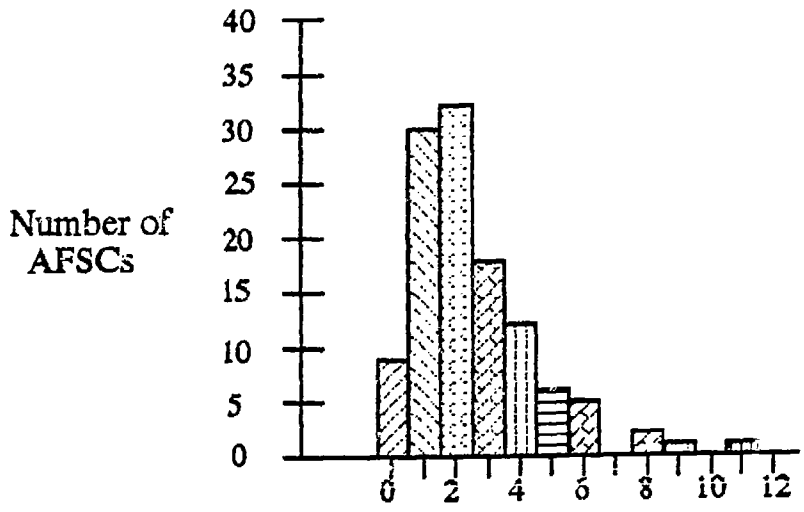
Table 3. Comparison of crude rates of the 117 AFSCs(N=93,854) with the crude rate of the 1992 Air Force Annual Hearing Conservation Report (AFHCR) and adjusted rates of the 117 AFSCs.

	Officer	Enlisted	Civilian	All
AFHCR Crude	1.7	2.0	4.8	2.5
117 AFSCs Crude	1.41	1.98	5.10	2.28
117 AFSCs Adjusted	1.45	2.72	2.83	2.49

The range of adjusted rates (risks) for all 117 AFSCs ranged from 0% to 11.38% (Figure 3). The majority of the AFSCs fell between adjusted rates of 0.5% and 4.5%. The

distribution of the risk is skewed to the right with several AFSCs as outlyers.

Figure 3. Number of Air Force Skill Codes (AFSCs) in different adjusted rate categories.



The adjusted risk for each one of the 117 AFSCs were summarized in a single table. The table was then sorted from highest risk to lowest risk according to enlisted, officer, and civilian (Appendix E). Lastly, the ten AFSCs with the highest and lowest risks of hearing losses were summarized (Table 4). The actual calculations of the highest (Appendix F) and lowest (Appendix G) were reported also.

Only four AFSCs were above an adjusted rate of 7.0%. Of those, three were civilian: Aircraft mechanic, Structural civil engineer, and vehicle maintenance. The one enlisted category above an adjusted rate of seven was radar technician. The highest risk calculated was on the civilian Aircraft mechanic at 11.38%.

It is interesting to note that six of the AFSCs with the greatest hearing loss were

Table 4. Summary of Ten AFSCs with the highest and lowest risk of developing PTS

Ten AFSC at highest risk of PTS (Ordered highest to least)				Ten AFSC at lowest risk of PTS (Ordered lowest to highest)			
Title	AFSC	Risk	Confid. Interval	Title	AFSC	Risk	Confid. Interval
Aircraft Mechanic	C-8840	11.38%	17.92% 4.85%	A.L. Missile Systems	E-466XX	0.00%	0.00% 0.00%
Structural civ.eng.	C-552XX	8.61%	15.86% 1.37%	Nuclear Weapons	E-463XX	0.00%	0.00% 0.00%
Vehicle Mainten.	C-472XX	8.37%	15.34% 1.39%	Instru-mentalist	E-872XX	0.00%	0.00% 0.00%
Radar Technician	E-303XX	8.30%	10.87% 5.73%	SpecialOps Pilot	O-1315	0.00%	0.00% 0.00%
Aeromedic Specialist	E-901XX	6.72%	12.00% 1.43%	PilotTrainee	O-0006	0.00%	0.00% 0.00%
Avionics Technician	E-451XX	6.26%	10.08% 2.43%	Aircraft Pneudraul.	C-8268	0.26%	0.75% -0.24%
Jet Eng. Mechanic	E-426XX	6.00%	9.29% 2.72%	Medical Service	E-902XX	0.27%	0.47% 0.06%
Machine Tool Oper	C-3431	5.75%	8.67% 2.83%	Combat Control	E-273XX	0.30%	0.88% -0.28%
Aircraft Ordinance	C-6652	5.64%	10.23% 1.04%	SpecialOps Nav	O-1585	0.42%	1.23% -0.39%
Aircraft Mainten.	C-452XX	5.44%	9.10% 1.79%	Electronic Com.	E-304XX	0.51%	1.22% -0.19%

civilian categories. This is particularly important in light of the fact that out of the 117 AFSCs analyzed only 33 (28%) were civilian. It appears that several civilian categories have higher risk of PTS than other categories even after adjusting for age, race, and sex.

The spread of the confidence intervals was greatly affected by the number within an

AFSC. For instance, the civilian AFSC 3431 (Machine tool operator) had a much narrower range with 289 employees versus the civilian AFSC 8840 (Aircraft mechanic) with 108 employees. There is significant overlap of many confidence intervals. Certainly the lower limits of the civilian Aircraft mechanic (4.85%) and the enlisted Radar technician (5.73%) are well above the group of AFSCs noted in Figure 3.

SECTION IV
DISCUSSION

Millions of dollars are paid annually to claimants of civilian DOD employees and past military personnel. All three services contribute substantially to this cost. In addition to cost, these injuries inflict undue disabilities on many of these individuals.

The data in this study are extremely valuable and should be replicated in the future with each subsequent year group. By analyzing data directly by the AFSC, managers at base level will be able to review programs for specific high and low risk groups. High risk groups can be monitored more closely, trained better, or other preventive measures can be implemented to take them off the high risk group. Conversely, low risk groups can be analyzed to see what is being done in that occupation to keep them in such a low risk. Perhaps some of their mechanisms can be duplicated in other areas to decrease the risk of hearing loss. This investigative work will surely generate paradigm shifts in the way the Air Force manages its AFHCP.

In particular the Air Force should pay particular attention to certain high risk civilian AFSCs. Since the civilians overall adjusted rate is very similar to the enlisted overall adjusted rate, it is particularly alarming to find a disproportionate number of civilian AFSCs in the top ten risk rankings.

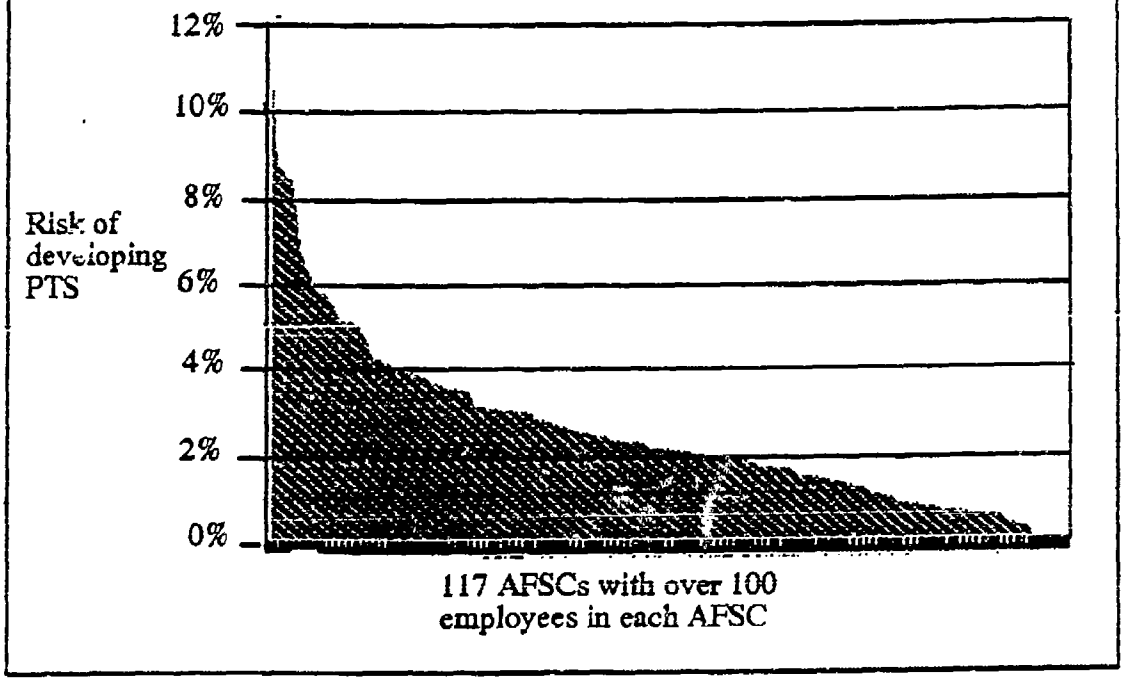
Finding the enlisted AFSC 901XX (Aeromedical Specialist) seems out of place as one of the top ten risks for hearing loss. Many individuals in this occupation are on the hearing conservation program since they are required to fly periodically. Yet to the researcher their exposure seems minimal when compared to most other AFSCs on the AFHCP. The question of why this group appears in the top ten list may have two plausible answers. With wide 95% confidence intervals, it may be in its ranking by chance from the multiple comparisons issue. Another explanation may be that since this is the AFSC that administers the audiograms in the Air Force, their ability to take audiograms may be different from that of the rest of the subcohort.

The Air Force should not take any major action on this study alone. Until a AFSC has reoccurred in the highest risk or lowest risk category 2 years in a row it may not be valid. Validity of this study may be affected by two factors.

Multiple comparison issues has been cited by authors a potential problem when analyzing large amounts of data. In essence, it states that because of the laws of probability, given a large enough sample, some variables will be statistically significant when they

really are due to chance of occurrence. [7] The application here is that an AFSC that was in the left end of the curve (high risk) in 1992 may end up in the center next year. It may have just randomly appeared as a high risk this year when in fact it is not a historically high risk group (Figure 4).

Figure 4. Distribution of risk of developing PTS among AFSCs with over 100 employees in each AFSC.



As second area validity may have been sacrificed was when the 4,648 AFSC codes were combined to the 2,718 AFSC codes. Although experts at Randolph AFB were consulted, misclassification of exposure may have occurred. Some decisions whether to combine codes into a parent code where complicated and time consuming. The researcher did his best to double check all decisions and entries. Even though these efforts were made validity may have been altered.

Precision of the results are also a concern. Since the goal was to analyze AFSCs, removing females early in the study was probably wise. In the future though, as women increase in percentages of the workforce, they should also be examined. Stratifying by age was prudent and would be a well recognized method to control for such a strong risk factor.

Race and/or melanin content of the inner ear has been implicated as a risk factor and was therefore adjusted for in the analysis. This adjustment may have decreased precision for no reason at all if race is not a strong risk factor in the military setting. Future studies should be performed to evaluate race as a risk factor for occupationally related hearing loss in the military.

Certain potential confounders were not controlled for in the design or analysis. Smoking, eye color, nonoccupational noise exposures have not been recorded on any easily accessible database in the Air Force; therefore, they were not adjusted for. It is hoped that smoking and nonoccupational noise exposures are evenly distributed through the AFSCs so they will not skew the results.

The greatest concern for precision surrounds the issue of what number of employees is a reasonable number to use as a cut-off for analysis. One hundred was used in this study with very rational reasoning. Unfortunately, from looking at the results closely one can see that even with this number of employees the adjusted risk can be easily altered by one or two PTSs in the AFSC. This factor is reflected in the wide confidence intervals. In future studies this cut-off may need to be altered.

SECTION V
RECOMMENDATIONS

The validity and precision issues that have been raised should not minimize the value of this study. If the study is replicated with 1993 data and similar results are found, Air Force management can confidently approach managers and Military Public Health Officers at base level to follow through with their investigative work to improve the AFHCP.

The Air Force is currently combining several databases at a central location. Within one to two years the access and quality of the data should be better. Race information will be easier to obtain. Generation of AFSCs that will not require manual and computer combining to parent codes will be likely. An Air Force computer programmer should build a program that will automatically generate this study. Even though this study was labor intensive, by using the avenues soon available much of the work intensity should be alleviated.

Appendix A

Example of printout with AFSCs broken out into 4648 different AFSC codes

ANALYSIS FOR EACH OCCUPATIONAL GROUP

OCCUPATIONAL CODE	MILITARY N	MILITARY %	CIVILIAN N	CIVILIAN %	ALL N	ALL %
452XB	1	0.00	0	0	1	0.00
452X0	167	0.15	9	0.01	176	0.16
452X1	147	0.13	4	0.00	151	0.13
452X2	233	0.21	2	0.00	235	0.21
452X3	77	0.07	0	0	77	0.07
452X4	1,569	1.38	18	0.02	1,587	1.40
452X5	237	0.21	1	0.00	238	0.21
452X7	19	0.02	0	0	19	0.02
452X9	5	0.00	2	0.00	7	0.01
452Y2	1	0.00	0	0	1	0.00
452Y4	1	0.00	0	0	1	0.00
4520	1	0.00	0	0	1	0.00
45200	26	0.02	2	0.00	28	0.02
4521	4	0.00	0	0	4	0.00
45210	1	0.00	0	0	1	0.00
45211	8	0.01	0	0	8	0.01
45212	1	0.00	0	0	1	0.00
45214	6	0.01	0	0	6	0.01
45215	1	0.00	0	0	1	0.00
45216	1	0.00	0	0	1	0.00
45222	1	0.00	0	0	1	0.00
45223	1	0.00	0	0	1	0.00
45224	1	0.00	0	0	1	0.00
4523	1	0.00	0	0	1	0.00
45230	2	0.00	1	0.00	3	0.00
45231	37	0.03	0	0	37	0.03
45232	56	0.05	1	0.00	57	0.05

(CONTINUED)

Appendix B

Air Force Specialty Codes(AFSC) containing 100 or more employees

	Officer**			Civilian* **		
	AFSC Codes	Number in AFSC	totals	AFSC Codes	Number in AFSC	totals
1	454..	8682	8682	1115	3756	3756	3806	2284	2284
2	452..	7886	16568	1045	2577	6333	8852	2225	4509
3	457..	5993	22561	1065	1803	8136	571..	568	5077
4	462..	3507	26068	1355	1639	9775	8602	566	5643
5	113..	2951	29019	1055	1559	11334	3414	565	6208
6	114..	2645	31664	1545	858	12192	81	525	6733
7	455..	2205	33869	1535	846	13038	2892	482	7215
8	458..	2083	35952	1575	658	13696	4102	445	7660
9	571..	1960	37912	1745	618	14314	454..	410	8070
10	631..	1840	39752	1235	609	14923	5378	342	8412
11	811..	1778	41530	1525	596	15519	8255	309	8721
12	461..	1322	42852	1555	563	16082	3431	289	9010
13	272..	1319	44171	9356	480	16562	551..	277	9287
14	551..	1265	45436	2225	383	16945	5402	250	9537
15	552..	1042	46478	1825	341	17286	3703	245	9782
16	902..	1007	47485	1325	335	17621	8268	223	10005
17	472..	1004	48489	9016	277	17898	6652	216	10221
18	112..	960	49449	1455	267	18165	2604	215	10436
19	605..	935	50384	1025	240	18405	6968	205	10641
20	542..	907	51291	1565	239	18644	3500	200	10841
21	545..	886	52177	1145	219	18863	552..	196	11037
22	431..	822	52999	1435	204	19067	457..	191	11228
23	456..	645	53644	1425	201	19268	545..	187	11415
24	411..	600	54244	6	193	19461	458..	164	11579
25	208..	513	54757	1495	192	19653	472..	157	11736
26	116..	390	55147	9766	161	19814	431..	138	11874
27	423..	382	55529	2255	157	19971	452..	121	11995
28	753..	321	55850	1716	152	20123	4604	118	12113
29	901..	315	56165	2245	149	20272	2805	114	12227

* These codes sometimes end in a 2 digit suffix. Two periods stand for the suffix which could be any 2 numerals. In other references this designation is often XX rather than two periods.

** If these codes have less than four digits, it can be assumed it is preceded by enough zeros to make it a four digit code.

Appendix B

Air Force Skill Codes(AFSC) containing 100 or more employees

	Enlisted*			Officer**			Civilian* **		
	AFSC Codes	Number in AFSC	totals	AFSC Codes	Number In AFSC	totals	AFSC Codes	Number in AFSC	totals
30	427..	281	56446	1585	148	20420	542..	109	12336
31	118..	280	56726	1315	146	20566	8840	108	12444
32	117..	271	56997	1595	143	20709	5413	104	12548
33	361..	271	57268	2865	120	20829	8800	101	12649
34	207..	264	57532	4024	119	20948	3705	99	12748
35	304..	264	57796	2295	115	21063	8862	98	12846
36	426..	230	58026	36	107	21170	5705	92	12938
37	871..	229	58255	66	88	21258	6907	88	13026
38	273..	218	58473	51115	86	21344	5309	87	13113
39	566..	210	58683	1445	81	21425	2854	87	13200
40	115..	208	58891	1365	80	21505	5823	86	13286
41	122..	169	59060	2265	73	21578	6912	84	13370
42	602..	163	59223	1035	73	21651	5350	84	13454
43	303..	156	59379	1406	68	21719	3416	83	13537
44	872..	147	59526	9025	64	21783	90850	81	13618
45	911..	137	59663	1634	63	21846	4352	81	13699
46	451..	130	59793	1335	55	21901	605..	79	13778
47	463..	125	59918	4016	54	21955	4204	79	13857
48	466..	117	60035	7	54	22009	427..	74	13931
49	453..	97	60132	2	48	22057	4206	74	14005
50	645..	86	60218	26	47	22104	3809	70	14075
51	275..	76	60294	940	47	22151	7408	68	14143
52	996..	64	60358	2724	42	22193	3858	66	14209
53	901..	63	60421	2815	39	22232	5352	66	14275
54	997..	62	60483	5525	38	22270	2606	60	14335
55	111..	60	60543	5516	38	22308	455..	59	14394
56	231..	59	60602	2825	37	22345	566..	59	14453
57	328..	57	60659	1465	37	22382	7407	58	14511
58	425..	55	60714	8	33	22415	2810	58	14569

* These codes sometimes end in a 2 digit suffix. Two periods stand for the suffix which could be any 2 numerals. In other references this designation is often XX rather than two periods.

** If these codes have less than four digits, it can be assumed it is preceded by enough zeros to make it a four digit code.

Appendix B

Air Force Skill Codes(AFSC) containing 100 or more employees

	Enlisted*			Officer**			Civilian* **		
	AFSC Codes	Number in AFSC	totals	AFSC Codes	Number In AFSC	totals	AFSC Codes	Number in AFSC	totals
59	316..	54	60768	2716	33	22448	3707	58	14627
60	392..	53	60821	6054	30	22478	462..	55	14682
61	908..	47	60868	46	30	22508	4605	55	14737
62	464..	47	60706	76	29	22411	5716	54	14565
63	251..	44	60750	2875	27	22438	5439	51	14616
64	995..	40	60790	8075	27	22465	3359	50	14666
				N/107,421		No. of AFSC:		% above 117	
	total for ≥ 100		93854	87.37%			117		1
	total for ≥ 80		95422	88.83%			135		115%
	total for ≥ 70		96020	89.39%			143		122%
	total for ≥ 50		97722	90.97%			172		147%

* These codes sometimes end in a 2 digit suffix. Two periods stand for the suffix which could be any 2 numerals. In other references this designation is often XX rather than two periods.

** If these codes have less than four digits, it can be assumed it is preceded by enough zeros to make it a four digit code.

Appendix C

ANALYSIS FOR EACH AFSC CODE

Race, Age	Annual Audio	No. of PTS (diseased) Risk	Stratum Crude	Standard weight(w) Risk	Stratum Adjusted	Conf. addends
1.white,18-27	n	d	n/d	w 0.1942	(n/d)w	$w\sqrt{\frac{(d/n)(1-d/n)}{n}}$
2.white,28-37				0.2994		
3.white,38-47				0.1253		
4.white, >47				0.0425		
5.black,18-27				0.0207		
6.black,28-37				0.0345		
7.black,38-47				0.0143		
8.black, >47				0.0050		
9.other,18-27				0.0596		
10.other,28-37				0.1059		
11.other,38-47				0.0691		
12.other, >47				0.0294		
				Sums=	Adjusted Rate	

Crude Risk calculation:

				Confidence Interval	

Confidence interval for direct adjustment:

Point Estimate +or- 1.96 $\sqrt{\sum W_i^2\left(\frac{(d_i/n_i)(1-d_i/n_i)}{n_i}\right)}$

Appendix D

ANALYSIS FOR Civilian AFSC 3431

Race, Age	Annual Audio	No. of PTS (diseased) Risk	Stratum Crude	Standard weight(w) Risk	Stratum Adjusted	Conf. addends
1.white,18-27	4	0	0	0.1942	0	0
2.white,28-37	41	1	0.024390	0.2994	0.007302	0.000052
3.white,38-47	31	3	0.096774	0.1253	0.012125	0.000044
4.white, >47	18	2	0.111111	0.0425	0.004722	0.000009
5.black,18-27	3	0	0	0.0207	0	0
6.black,28-37	3	1	0.333333	0.0345	0.011500	0.000088
7.black,38-47	5	0	0	0.0143	0	0
8.black, >47	3	0	0	0.0050	0	0
9.other,18-27	31	1	0.322580	0.0596	0.001922	0.000003
10.other,28-37	71	4	0.056338	0.1059	0.005966	0.000008
11.other,38-47	61	8	0.131147	0.0691	0.009062	0.000008
12.other, >47	18	3	0.166666	0.0294	0.004900	0.000006
				Sums=	**0.057501**	0.000221
Totals	289	23	0.079584	Confidence Interval	**0.086700** **0.028302**	

Crude Risk calculation:

Confidence interval for direct adjustment:

Point Estimate +or- 1.96 $\sqrt{\sum W_i^2\left(\frac{(d_i/n_i)(1-d_i/n_i)}{n_i}\right)}$

Appendix E

Adjusted Risk for all AFSCs with 100 or more individuals

	ENLISTED *			OFFICER			CIVILIAN *		
	N	AFSC	AdjRisk	N	AFSC	AdjRisk	N	AFSC	AdjRisk
1	156	303..	0.08302	219	1145	0.05026	108	8840	0.11388
2	315	901..	0.06719	115	2295	0.04588	196	552..	0.08613
3	130	451..	0.06257	201	1425	0.04169	157	472..	0.08369
4	230	426..	0.06001	143	1595	0.03068	289	3431	0.0575
5	281	427..	0.05061	277	9016	0.02643	216	6652	0.05637
6	210	566..	0.05012	563	1555	0.0242	121	452..	0.05444
7	1322	461..	0.04785	267	1455	0.02406	445	4102	0.04003
8	163	602..	0.04176	240	1025	0.02261	104	5413	0.03936
9	600	411..	0.04113	239	1565	0.02215	277	551..	0.0376
10	822	431..	0.03872	120	2865	0.02098	245	3703	0.03602
11	2083	458..	0.03859	618	1745	0.01937	309	8255	0.0304
12	169	122..	0.03783	335	1325	0.01877	114	2805	0.02971
13	1840	631..	0.03642	152	1716	0.01858	2284	3806	0.02962
14	7886	452..	0.03509	3756	1115	0.01605	342	5378	0.0277
15	5993	457..	0.03508	157	2255	0.01506	2225	8852	0.02516
16	907	542..	0.03473	204	1435	0.01464	164	458..	0.02506
17	390	116..	0.03441	858	1545	0.01459	565	3414	0.02282
18	1042	552..	0.03075	383	2225	0.01349	525	OO81	0.02282
19	1265	551..	0.03073	107	OO36	0.01317	109	542..	0.02259
20	2205	455..	0.02999	596	1525	0.01261	215	2604	0.02253
21	382	423..	0.0299	846	1535	0.01213	566	8602	0.02071
22	645	456..	0.02939	1559	1055	0.01195	410	454..	0.02063
23	208	115..	0.02786	1639	1355	0.01005	482	2892	0.02031
24	8682	454..	0.0272	1803	1065	0.00849	138	431..	0.01961
25	960	112..	0.02606	192	1495	0.00839	205	6908	0.01946
26	3507	462..	0.0249	658	1575	0.00781	187	545..	0.01929
27	1004	472..	0.02387	480	9356	0.0078	568	571..	0.01865
28	935	605..	0.02078	2577	1045	0.00696	250	5402	0.01657
29	885	545..	0.02007	119	4024	0.00665	118	4604	0.01446
30	321	753..	0.01893	341	1825	0.0063	101	8800	0.01317
31	2645	114..	0.01825	609	1235	0.0058	200	3500	0.00708

* These codes sometimes end in a 2 digit suffix. Two periods stand for the suffix which could be any 2 numerals. In other references this designation is often XX rather than two periods.

Appendix E

Adjusted Risk for all AFSCs with 100 or more individuals

	ENLISTED *			OFFICER			CIVILIAN *		
	N	AFSC	AdjRisk	N	AFSC	AdjRisk	N	AFSC	AdjRisk
32	1319	272..	0.01743	149	2245	0.00543	191	457..	0.00548
33	2[illegible]57	113..	0.01677	161	9766	0.00533	223	8268	0.00255
34	1778	811..	0.01637	148	1585	0.00415			
35	1960	571..	0.01604	193	OOO6	0			
36	271	361..	0.01391	146	1315	0			
37	271	117..	0.01053						
38	264	207..	0.00966						
39	280	118..	0.00944						
40	513	208..	0.00745						
41	137	911..	0.0068						
42	229	871..	0.0055						
43	264	304..	0.00512						
44	218	273..	0.00299						
45	1007	902..	0.00267						
46	147	872..	0						
47	125	463..	0						
48	117	466..	0						

* These codes sometimes end in a 2 digit suffix. Two periods stand for the suffix which could be any 2 numerals. In other references this designation is often XX rather than two periods.

ANALYSIS FOR CIVILIAN AFSC: 8840

RACE	AGE	NUM ANNUAL AUDIOGRAMS	NUM WITH PTS	STRATUM CRUDE RISK	STANDARD WEIGHT	STRATUM ADJUSTED RISK	CONFIDENCE ADDENDS
WHITE	18-27	3	0	0.000000000	0.1942	0.000000000	0.000000000
	28-37	30	5	0.166666667	0.2994	0.049900000	0.000415002
	38-47	29	4	0.137931034	0.1253	0.017282759	0.000064374
	> 47	19	2	0.105263158	0.0425	0.004473684	0.000008954
BLACK	18-27	0	0	0.000000000	0.0207	0.000000000	0.000000000
	28-37	0	0	0.000000000	0.0345	0.000000000	0.000000000
	38-47	3	0	0.000000000	0.0143	0.000000000	0.000000000
	> 47	3	0	0.000000000	0.0050	0.000000000	0.000000000
OTHER	18-27	0	0	0.000000000	0.0596	0.000000000	0.000000000
	28-37	4	1	0.250000000	0.1059	0.026475000	0.000525694
	38-47	7	1	0.142857143	0.0691	0.009871429	0.000083524
	> 47	10	2	0.200000000	0.0294	0.005880000	0.000013830
TOTALS		108	15	0.138888889		0.113882871	0.001111377

CONFIDENCE INTERVAL = 0.179224028(+)

0.048541714(-)

ANALYSIS FOR CIVILIAN AFSC: 552XX

RACE	AGE	NUM ANNUAL AUDIOGRAMS	NUM WITH PTS	STRATUM CRUDE RISK	STANDARD WEIGHT	STRATUM ADJUSTED RISK	CONFIDENCE ADDENDS
WHITE	18-27	1	0	0.000000000	0.1942	0.000000000	0.000000000
	28-37	11	2	0.181818182	0.2994	0.054436364	0.001212266
	38-47	54	3	0.055555556	0.1253	0.006961111	0.000015255
	> 47	53	8	0.150943396	0.0425	0.006415094	0.000004368
BLACK	18-27	1	0	0.000000000	0.0207	0.000000000	0.000000000
	28-37	2	0	0.000000000	0.0345	0.000000000	0.000000000
	38-47	4	0	0.000000000	0.0143	0.000000000	0.000000000
	> 47	3	0	0.000000000	0.0059	0.000000000	0.000000000
OTHER	18-27	2	0	0.000000000	0.0596	0.000000000	0.000000000
	28-37	9	1	0.111111111	0.1059	0.011766667	0.000123071
	38-47	25	1	0.040000000	0.0691	0.002764000	0.000007334
	> 47	31	4	0.129032258	0.0294	0.003793548	0.000003134
TOTALS		196	19	0.096938776		0.086136784	0.001365427

CONFIDENCE INTERVAL = 0.158562094(+)

0.013711475(-)

ANALYSIS FOR CIVILIAN AFSC: 472XX

RACE	AGE	NUM ANNUAL AUDIOGRAMS	NUM WITH PTS	STRATUM CRUDE RISK	STANDARD WEIGHT	STRATUM ADJUSTED RISK	CONFIDENCE ADDENDS
WHITE	18-27	5	0	0.000000000	0.1942	0.000000000	0.000000000
	28-37	11	1	0.090909091	0.2994	0.027218182	0.000673481
	38-47	39	4	0.102564103	0.1253	0.012851282	0.000037054
	> 47	55	12	0.218181818	0.0425	0.009272727	0.000005602
BLACK	18-27	0	0	0.000000000	0.0207	0.000000000	0.000000000
	28-37	1	0	0.000000000	0.0345	0.000000000	0.000000000
	38-47	8	0	0.000000000	0.0143	0.000000000	0.000000000
	> 47	1	0	0.000000000	0.0050	0.000000000	0.000000000
OTHER	18-27	0	0	0.000000000	0.0596	0.000000000	0.000000000
	28-37	4	1	0.250000000	0.1059	0.026475000	0.000525694
	38-47	15	1	0.066666667	0.0691	0.004606667	0.000019807
	> 47	18	2	0.111111111	0.0294	0.003266667	0.000004743
TOTALS		157	21	0.133757962		0.083690524	0.001266381

CONFIDENCE INTERVAL = 0.153439567(+)

0.013941482(-)

ANALYSIS FOR ENLISTED AFSC: 303XX

RACE	AGE	NUM ANNUAL AUDIOGRAMS	NUM WITH PTS	STRATUM CRUDE RISK	STANDARD WEIGHT	STRATUM ADJUSTED RISK	CONFIDENCE ADDENDS
WHITE	18-27	53	0	0.000000000	0.1942	0.000000000	0.000000000
	28-37	56	0	0.000000000	0.2994	0.000000000	0.000000000
	38-47	9	1	0.111111111	0.1253	0.013922222	0.000172292
	> 47	1	0	0.000000000	0.0425	0.000000000	0.000000000
BLACK	18-27	9	0	0.000000000	0.0207	0.000000000	0.000000000
	28-37	5	0	0.000000000	0.0345	0.000000000	0.000000000
	38-47	0	0	0.000000000	0.0143	0.000000000	0.000000000
	> 47	0	0	0.000000000	0.0050	0.000000000	0.000000000
OTHER	18-27	9	0	0.000000000	0.0596	0.000000000	0.000000000
	28-37	13	0	0.000000000	0.1059	0.000000000	0.000000000
	38-47	1	1	1.000000000	0.0691	0.069100000	0.000000000
	> 47	0	0	0.000000000	0.0294	0.000000000	0.000000000
TOTALS		156	2	0.012820513		0.083022222	0.000172292

CONFIDENCE INTERVAL = 0.108749176(+)

0.057295268(-)

ANALYSIS FOR ENLISTED AFSC: 901XX

RACE	AGE	NUM ANNUAL AUDIOGRAMS	NUM WITH PTS	STRATUM CRUDE RISK	STANDARD WEIGHT	STRATUM ADJUSTED RISK	CONFIDENCE ADDENDS
WHITE	18-27	79	0	0.000000000	0.1942	0.000000000	0.000000000
	28-37	108	1	0.009259259	0.2994	0.002772222	0.000007614
	38-47	25	5	0.200000000	0.1253	0.025060000	0.000100481
	> 47	2	0	0.000000000	0.0425	0.000000000	0.000000000
BLACK	18-27	14	0	0.000000000	0.0207	0.000000000	0.000000000
	28-37	24	0	0.000000000	0.0345	0.000000000	0.000000000
	38-47	5	0	0.000000000	0.0143	0.000000000	0.000000000
	> 47	0	0	0.000000000	0.0050	0.000000000	0.000000000
OTHER	18-27	34	0	0.000000000	0.0596	0.000000000	0.000000000
	28-37	22	1	0.045454545	0.1059	0.004813636	0.000022118
	38-47	2	1	0.500000000	0.0691	0.034550000	0.000596851
	> 47	0	0	0.000000000	0.0294	0.000000000	0.000000000
TOTALS		315	8	0.025396825		0.067195859	0.000727064

CONFIDENCE INTERVAL = 0.120045533(+)

0.014346184(-)

ANALYSIS FOR ENLISTED AFSC: 451XX

RACE	AGE	NUM ANNUAL AUDIOGRAMS	NUM WITH PTS	STRATUM CRUDE RISK	STANDARD WEIGHT	STRATUM ADJUSTED RISK	CONFIDENCE ADDENDS
WHITE	18-27	25	0	0.000000000	0.1942	0.000000000	0.000000000
	28-37	53	2	0.037735849	0.2994	0.011298113	0.000061415
	38-47	25	5	0.200000000	0.1253	0.025060000	0.000100481
	> 47	2	0	0.000000000	0.0425	0.000000000	0.000000000
BLACK	18-27	3	0	0.000000000	0.0207	0.000000000	0.000000000
	28-37	2	0	0.000000000	0.0345	0.000000000	0.000000000
	38-47	1	0	0.000000000	0.0143	0.000000000	0.000000000
	> 47	0	0	0.000000000	0.0050	0.000000000	0.000000000
OTHER	18-27	2	0	0.000000000	0.0596	0.000000000	0.000000000
	28-37	9	0	0.000000000	0.1059	0.000000000	0.000000000
	38-47	6	1	0.166666667	0.0691	0.011516667	0.000110528
	> 47	2	1	0.500000000	0.0294	0.014700000	0.000108045
TOTALS		130	9	0.069230769		0.062574780	0.000380469

CONFIDENCE INTERVAL = 0.160805776(+)

0.024343784(-)

ANALYSIS FOR ENLISTED AFSC: 426XX

RACE	AGE	NUM ANNUAL AUDIOGRAMS	NUM WITH PTS	STRATUM CRUDE RISK	STANDARD WEIGHT	STRATUM ADJUSTED RISK	CONFIDENCE ADDENDS
WHITE	18-27	24	1	0.041666667	0.1942	0.008091667	0.000062747
	28-37	82	3	0.036585366	0.2994	0.010953659	0.000038531
	38-47	39	3	0.076923077	0.1253	0.009638462	0.000028585
	> 47	11	2	0.181818182	0.0425	0.007727273	0.000024427
BLACK	18-27	1	0	0.000000000	0.0207	0.000000000	0.000000000
	28-37	11	0	0.000000000	0.0345	0.000000000	0.000000000
	38-47	4	0	0.000000000	0.0143	0.000000000	0.000000000
	> 47	2	0	0.000000000	0.0050	0.000000000	0.000000000
OTHER	18-27	7	1	0.142857143	0.0596	0.008514286	0.000062137
	28-37	29	0	0.000000000	0.1059	0.000000000	0.000000000
	38-47	15	2	0.133333333	0.0691	0.009213333	0.000036784
	> 47	5	1	0.200000000	0.0294	0.005880000	0.000027660
TOTALS		230	13	0.056521739		0.060018679	0.000280870

CONFIDENCE INTERVAL = 0.092866654(+)

0.027170703(-)

ANALYSIS FOR CIVILIAN AFSC: 3431

RACE	AGE	NUM ANNUAL AUDIOGRAMS	NUM WITH PTS	STRATUM CRUDE RISK	STANDARD WEIGHT	STRATUM ADJUSTED RISK	CONFIDENCE ADDENDS
WHITE	18-27	4	0	0.000000000	0.1942	0.000000000	0.000000000
	28-37	41	1	0.024390244	0.2994	0.007302439	0.000052025
	38-47	31	3	0.096774194	0.1253	0.012125806	0.000044269
	> 47	18	2	0.111111111	0.0425	0.004722222	0.000009911
BLACK	18-27	3	0	0.000000000	0.0207	0.000000000	0.000000000
	28-37	3	1	0.333333333	0.0345	0.011500000	0.000088167
	38-47	5	0	0.000000000	0.0143	0.000000000	0.000000000
	> 47	3	0	0.000000000	0.0050	0.000000000	0.000000000
OTHER	18-27	31	1	0.032258065	0.0596	0.001922581	0.000003577
	28-37	71	4	0.056338028	0.1059	0.005966197	0.000008398
	38-47	61	8	0.131147541	0.0691	0.009062295	0.000008919
	> 47	18	3	0.166666667	0.0294	0.004900000	0.000006669
TOTALS		289	23	0.079584775		0.057501541	0.000221935

CONFIDENCE INTERVAL = 0.086700577(+)

0.028302504(-)

ANALYSIS FOR CIVILIAN AFSC: 6652

RACE	AGE	NUM ANNUAL AUDIOGRAMS	NUM WITH PTS	STRATUM CRUDE RISK	STANDARD WEIGHT	STRATUM ADJUSTED RISK	CONFIDENCE ADDENDS
WHITE	18-27	9	1	0.111111111	0.1942	0.021577778	0.000413867
	28-37	70	1	0.014285714	0.2994	0.004277143	0.000018033
	38-47	87	7	0.080459770	0.1253	0.010081609	0.000013352
	> 47	19	3	0.157894737	0.0425	0.006710526	0.000012640
BLACK	18-27	0	0	0.000000000	0.0207	0.000000000	0.000000000
	28-37	1	0	0.000000000	0.0345	0.000000000	0.000000000
	38-47	5	0	0.000000000	0.0143	0.000000000	0.000000000
	> 47	0	0	0.000000000	0.0050	0.000000000	0.000000000
OTHER	18-27	0	0	0.000000000	0.0596	0.000000000	0.000000000
	28-37	12	1	0.083333333	0.1059	0.008825000	0.000071391
	38-47	7	0	0.000000000	0.0691	0.000000000	0.000000000
	> 47	6	1	0.166666667	0.0294	0.004900000	0.000020008
TOTALS		216	14	0.064814815		0.056372056	0.000549291

CONFIDENCE INTERVAL = 0.102308474(+)

0.010435639(-)

ANALYSIS FOR CIVILIAN AFSC: 452XX

RACE	AGE	NUM ANNUAL AUDIOGRAMS	NUM WITH PTS	STRATUM CRUDE RISK	STANDARD WEIGHT	STRATUM ADJUSTED RISK	CONFIDENCE ADDENDS
WHITE	18-27	5	0	0.000000000	0.1942	0.000000000	0.000000000
	28-37	27	2	0.074074074	0.2994	0.022177778	0.000227710
	38-47	24	3	0.125000000	0.1253	0.015662500	0.000071550
	> 47	23	4	0.173913043	0.0425	0.007391304	0.000011283
BLACK	18-27	0	0	0.000000000	0.0207	0.000000000	0.000000000
	28-37	2	0	0.000000000	0.0345	0.000000000	0.000000000
	38-47	0	0	0.000000000	0.0143	0.000000000	0.000000000
	> 47	2	0	0.000000000	0.0050	0.000000000	0.000000000
OTHER	18-27	2	0	0.000000000	0.0596	0.000000000	0.000000000
	28-37	11	0	0.000000000	0.1059	0.000000000	0.000000000
	38-47	15	2	0.133333333	0.0691	0.009213333	0.000036784
	> 47	10	0	0.000000000	0.0294	0.000000000	0.000000000
TOTALS		121	11	0.090909091		0.054444915	0.000347326

CONFIDENCE INTERVAL = 0.090972832(+)

0.017916999(-)

ANALYSIS FOR ENLISTED AFSC: 466XX

RACE	AGE	NUM ANNUAL AUDIOGRAMS	NUM WITH PTS	STRATUM CRUDE RISK	STANDARD WEIGHT	STRATUM ADJUSTED RISK	CONFIDENCE ADDENDS
WHITE	18-27	44	0	0.000000000	0.1942	0.000000000	0.000000000
	28-37	44	0	0.000000000	0.2994	0.000000000	0.000000000
	38-47	5	0	0.000000000	0.1253	0.000000000	0.000000000
	> 47	0	0	0.000000000	0.0425	0.000000000	0.000000000
BLACK	18-27	6	0	0.000000000	0.0207	0.000000000	0.000000000
	28-37	1	0	0.000000000	0.0345	0.000000000	0.000000000
	38-47	1	0	0.000000000	0.0143	0.000000000	0.000000000
	> 47	0	0	0.000000000	0.0050	0.000000000	0.000000000
OTHER	18-27	9	0	0.000000000	0.0596	0.000000000	0.000000000
	28-37	6	0	0.000000000	0.1059	0.000000000	0.000000000
	38-47	1	0	0.000000000	0.0691	0.000000000	0.000000000
	> 47	0	0	0.000000000	0.0294	0.000000000	0.000000000
TOTALS		117	0	0.000000000		0.000000000	0.000000000

CONFIDENCE INTERVAL = 0.000000000(+)
0.000000000(-)

ANALYSIS FOR ENLISTED AFSC: 463XX

RACE	AGE	NUM ANNUAL AUDIOGRAMS	NUM WITH PTS	STRATUM CRUDE RISK	STANDARD WEIGHT	STRATUM ADJUSTED RISK	CONFIDENCE ADDENDS
WHITE	18-27	62	0	0.000000000	0.1942	0.000000000	0.000000000
	28-37	30	0	0.000000000	0.2994	0.000000000	0.000000000
	38-47	7	0	0.000000000	0.1253	0.000000000	0.000000000
	> 47	0	0	0.000000000	0.0425	0.000000000	0.000000000
BLACK	18-27	1	0	0.000000000	0.0207	0.000000000	0.000000000
	28-37	3	0	0.000000000	0.0345	0.000000000	0.000000000
	38-47	1	0	0.000000000	0.0143	0.000000000	0.000000000
	> 47	0	0	0.000000000	0.0050	0.000000000	0.000000000
OTHER	18-27	13	0	0.000000000	0.0596	0.000000000	0.000000000
	28-37	7	0	0.000000000	0.1059	0.000000000	0.000000000
	38-47	1	0	0.000000000	0.0691	0.000000000	0.000000000
	> 47	0	0	0.000000000	0.0294	0.000000000	0.000000000
TOTALS		125	0	0.000000000		0.000000000	0.000000000

CONFIDENCE INTERVAL = 0.000000000(+)

0.000000000(-)

ANALYSIS FOR ENLISTED AFSC: 872XX

RACE	AGE	NUM ANNUAL AUDIOGRAMS	NUM WITH PTS	STRATUM CRUDE RISK	STANDARD WEIGHT	STRATUM ADJUSTED RISK	CONFIDENCE ADDENDS
WHITE	18-27	6	0	0.000000000	0.1942	0.000000000	0.000000000
	28-37	69	0	0.000000000	0.2994	0.000000000	0.000000000
	38-47	47	0	0.000000000	0.1253	0.000000000	0.000000000
	> 47	1	0	0.000000000	0.0425	0.000000000	0.000000000
BLACK	18-27	0	0	0.000000000	0.0207	0.000000000	0.000000000
	28-37	2	0	0.000000000	0.0345	0.000000000	0.000000000
	38-47	4	0	0.000000000	0.0143	0.000000000	0.000000000
	> 47	0	0	0.000000000	0.0050	0.000000000	0.000000000
OTHER	18-27	1	0	0.000000000	0.0596	0.000000000	0.000000000
	28-37	8	0	0.000000000	0.1059	0.000000000	0.000000000
	38-47	8	0	0.000000000	0.0691	0.000000000	0.000000000
	> 47	1	0	0.000000000	0.0294	0.000000000	0.000000000
TOTALS		147	0	0.000000000		0.000000000	0.000000000

CONFIDENCE INTERVAL = 0.000000000(+)
0.000000000(-)

ANALYSIS FOR OFFICER AFSC: 1315

RACE	AGE	NUM ANNUAL AUDIOGRAMS	NUM WITH PTS	STRATUM CRUDE RISK	STANDARD WEIGHT	STRATUM ADJUSTED RISK	CONFIDENCE ADDENDS
WHITE	18-27	11	0	0.000000000	0.1942	0.000000000	0.000000000
	28-37	76	0	0.000000000	0.2994	0.000000000	0.000000000
	38-47	25	0	0.000000000	0.1253	0.000000000	0.000000000
	> 47	1	0	0.000000000	0.0425	0.000000000	0.000000000
BLACK	18-27	0	0	0.000000000	0.0207	0.000000000	0.000000000
	28-37	3	0	0.000000000	0.0345	0.000000000	0.000000000
	38-47	1	0	0.000000000	0.0143	0.000000000	0.000000000
	> 47	0	0	0.000000000	0.0050	0.000000000	0.000000000
OTHER	18-27	3	0	0.000000000	0.0596	0.000000000	0.000000000
	28-37	17	0	0.000000000	0.1059	0.000000000	0.000000000
	38-47	8	0	0.000000000	0.0691	0.000000000	0.000000000
	> 47	1	0	0.000000000	0.0294	0.000000000	0.000000000
TOTALS		146	0	0.000000000		0.000000000	0.000000000

CONFIDENCE INTERVAL = 0.000000000(+)

0.000000000(-)

ANALYSIS FOR OFFICER AFSC: 0006

RACE	AGE	NUM ANNUAL AUDIOGRAMS	NUM WITH PTS	STRATUM CRUDE RISK	STANDARD WEIGHT	STRATUM ADJUSTED RISK	CONFIDENCE ADDENDS
WHITE	18-27	102	0	0.000000000	0.1942	0.000000000	0.000000000
	28-37	15	0	0.000000000	0.2994	0.000000000	0.000000000
	38-47	8	0	0.000000000	0.1253	0.000000000	0.000000000
	> 47	4	0	0.000000000	0.0425	0.000000000	0.000000000
BLACK	18-27	1	0	0.000000000	0.0207	0.000000000	0.000000000
	28-37	0	0	0.000000000	0.0345	0.000000000	0.000000000
	38-47	0	0	0.000000000	0.0143	0.000000000	0.000000000
	> 47	0	0	0.000000000	0.0050	0.000000000	0.000000000
OTHER	18-27	34	0	0.000000000	0.0596	0.000000000	0.000000000
	28-37	26	0	0.000000000	0.1059	0.000000000	0.000000000
	38-47	2	0	0.000000000	0.0691	0.000000000	0.000000000
	> 47	1	0	0.000000000	0.0294	0.000000000	0.000000000
TOTALS		193	0	0.000000000		0.000000000	0.000000000

CONFIDENCE INTERVAL = 0.000000000(+)

0.000000000(-)

ANALYSIS FOR CIVILIAN AFSC: 8268

RACE	AGE	NUM ANNUAL AUDIOGRAMS	NUM WITH PTS	STRATUM CRUDE RISK	STANDARD WEIGHT	STRATUM ADJUSTED RISK	CONFIDENCE ADDENDS
WHITE	18-27	5	0	0.000000000	0.1942	0.000000000	0.000000000
	28-37	55	0	0.000000000	0.2994	0.000000000	0.000000000
	38-47	48	0	0.000000000	0.1253	0.000000000	0.000000000
	> 47	42	0	0.000000000	0.0425	0.000000000	0.000000000
BLACK	18-27	0	0	0.000000000	0.0207	0.000000000	0.000000000
	28-37	2	0	0.000000000	0.0345	0.000000000	0.000000000
	38-47	9	0	0.000000000	0.0143	0.000000000	0.000000000
	> 47	2	0	0.000000000	0.0050	0.000000000	0.000000000
OTHER	18-27	2	0	0.000000000	0.0596	0.000000000	0.000000000
	28-37	14	0	0.000000000	0.1059	0.000000000	0.000000000
	38-47	27	1	0.037037037	0.0691	0.002559259	0.000006307
	> 47	17	0	0.000000000	0.0294	0.000000000	0.000000000
TOTALS		223	1	0.004464305		0.002559259	0.000006307

CONFIDENCE INTERVAL = 0.007481639(+)

-.002363121(-)

ANALYSIS FOR ENLISTED AFSC: 902XX

RACE	AGE	NUM ANNUAL AUDIOGRAMS	NUM WITH PTS	STRATUM CRUDE RISK	STANDARD WEIGHT	STRATUM ADJUSTED RISK	CONFIDENCE ADDENDS
WHITE	18-27	31	0	0.000000000	0.1942	0.000000000	0.000000000
	28-37	67	0	0.000000000	0.2994	0.000000000	0.000000000
	38-47	11	0	0.000000000	0.1253	0.000000000	0.000000000
	> 47	4	0	0.000000000	0.0425	0.000000000	0.000000000
BLACK	18-27	6	0	0.000000000	0.0207	0.000000000	0.000000000
	28-37	13	0	0.000000000	0.0345	0.000000000	0.000000000
	38-47	6	0	0.000000000	0.0143	0.000000000	0.000000000
	> 47	0	0	0.000000000	0.0050	0.000000000	0.000000000
OTHER	18-27	296	1	0.003378378	0.0596	0.000201351	0.000000040
	28-37	321	0	0.000000000	0.1059	0.000000000	0.000000000
	38-47	197	4	0.020304569	0.0691	0.001403046	0.000000482
	> 47	55	2	0.036363636	0.0294	0.001069091	0.000000551
TOTALS		1,007	7	0.006951341		0.002673488	0.000001073

CONFIDENCE INTERVAL = 0.004703999(+)

0.000642977(-)

ANALYSIS FOR ENLISTED AFSC: 273XX

RACE	AGE	NUM ANNUAL AUDIOGRAMS	NUM WITH PTS	STRATUM CRUDE RISK	STANDARD WEIGHT	STRATUM ADJUSTED RISK	CONFIDENCE ADDENDS
WHITE	18-27	61	0	0.000000000	0.1942	0.000000000	0.000000000
	28-37	100	1	0.010000000	0.2894	0.002994000	0.000008874
	38-47	19	0	0.000000000	0.1253	0.000000000	0.000000000
	> 47	1	0	0.000000000	0.0425	0.000000000	0.000000000
BLACK	18-27	1	0	0.000000000	0.0207	0.000000000	0.000000000
	28-37	6	0	0.000000000	0.0345	0.000000000	0.000000000
	38-47	1	0	0.000000000	0.0143	0.000000000	0.000000000
	> 47	0	0	0.000000000	0.0050	0.000000000	0.000000000
OTHER	18-27	11	0	0.000000000	0.0596	0.000000000	0.000000000
	28-37	15	0	0.000000000	0.1059	0.000000000	0.000000000
	38-47	3	0	0.000000000	0.0691	0.000000000	0.000000000
	> 47	0	0	0.000000000	0.0294	0.000000000	0.000000000
TOTALS		218	1	0.004587156		0.002994000	0.000008874

CONFIDENCE INTERVAL = 0.008832825(+)

-.002844825(-)

ANALYSIS FOR OFFICER AFSC: 1585

RACE	AGE	NUM ANNUAL AUDIOGRAMS	NUM WITH PTS	STRATUM CRUDE RISK	STANDARD WEIGHT	STRATUM ADJUSTED RISK	CONFIDENCE ADDENDS
WHITE	18-27	11	0	0.000000000	0.1942	0.000000000	0.000000000
	28-37	72	1	0.013888889	0.2994	0.004158333	0.000017052
	38-47	15	0	0.000000000	0.1253	0.000000000	0.000000000
	> 47	4	0	0.000000000	0.0425	0.000000000	0.000000000
BLACK	18-27	0	0	0.000000000	0.0207	0.000000000	0.000000000
	28-37	3	0	0.000000000	0.0345	0.000000000	0.000000000
	38-47	0	0	0.000000000	0.0143	0.000000000	0.000000000
	> 47	0	0	0.000000000	0.0050	0.000000000	0.000000000
OTHER	18-27	0	0	0.000000000	0.0596	0.000000000	0.000000000
	28-37	30	0	0.000000000	0.1059	0.000000000	0.000000000
	38-47	12	0	0.000000000	0.0691	0.000000000	0.000000000
	> 47	1	0	0.000000000	0.0294	0.000000000	0.000000000
TOTALS		148	1	0.006756757		0.004158333	0.000017052

CONFIDENCE INTERVAL = 0.012251869(+)

-.003935203(-)

ANALYSIS FOR ENLISTED AFSC: 304XX

RACE	AGE	NUM ANNUAL AUDIOGRAMS	NUM WITH PTS	STRATUM CRUDE RISK	STANDARD WEIGHT	STRATUM ADJUSTED RISK	CONFIDENCE ADDENDS
WHITE	18-27	67	0	0.000000000	0.1942	0.000000000	0.000000000
	28-37	117	2	0.017094017	0.2994	0.005117949	0.000012873
	38-47	12	0	0.000000000	0.1253	0.000000000	0.000000000
	> 47	0	0	0.000000000	0.0425	0.000000000	0.000000000
BLACK	18-27	13	0	0.000000000	0.0207	0.000000000	0.000000000
	28-37	15	0	0.000000000	0.0345	0.000000000	0.000000000
	38-47	1	0	0.000000000	0.0143	0.000000000	0.000000000
	> 47	0	0	0.000000000	0.0050	0.000000000	0.000000000
OTHER	18-27	19	0	0.000000000	0.0596	0.000000000	0.000000000
	28-37	15	0	0.000000000	0.1059	0.000000000	0.000000000
	38-47	5	0	0.000000000	0.0691	0.000000000	0.000000000
	> 47	0	0	0.000000000	0.0284	0.000000000	0.000000000
TOTALS		264	2	0.007575758		0.005117949	0.000012873

CONFIDENCE INTERVAL = 0.012150178(+)

-.001914280(-)

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Vita

Jim Alan Davis was born in Crystal City, Texas, on August 21, 1955, the son of Bert and Billie Margaret Davis. After graduating from Boling High School in 1973, he attended Wharton County Junior College, Wharton, Texas, until December 1974. He then transferred to Texas A&M, College Station, Texas, and graduated with a Bachelor of Science in Veterinary Medicine in 1977. His education continued at Texas A&M until he graduated with a Doctorate of Veterinary Medicine in August 1978. From 1978 to 1981 he was in the Army Veterinary Corps and was stationed at Ft. McClellan, Alabama, and then Fort Sam Houston, Texas. He left the military in 1981 and went into private veterinary practice in Houston, Texas until 1987. In August 1987 he joined the Air Force and has served as a Military Public Health officer to the present. He was stationed at Loring AFB, Maine from 1987 to 1991; Ellsworth AFB, South Dakota, from 1991 to 1992; and University of Texas at Houston as a student from 1992 to 1994. He is married to Brenda Darlene Davis and has three children : J. Andrew, age 19; Kristin, age 15; and Joshua, age 13.

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